

AD-A186 352

MATHEMATICAL TECHNIQUES FOR SYSTEM REALIZATION AND
IDENTIFICATION(U) FLORIDA UNIV GAINESVILLE CENTER FOR
MATHEMATICAL SYSTEM THEORY R E KALMAN 20 JUL 87

1/1

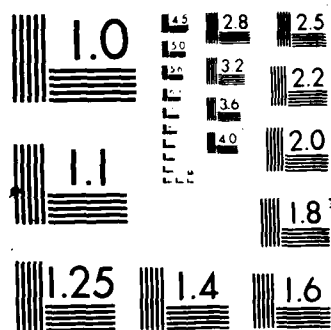
UNCLASSIFIED

AFOSR-TR-87-1330 \$AFOSR-85-0186

F/G 12/3

NL





AD-A186 352

DTIC FILE

2

DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

| | | | |
|---|-------|---|--|
| 1a. REPORT SECURITY CLASSIFICATION Unclassified | | 1b. RESTRICTIVE MARKINGS none | |
| 2a. SECURITY CLASSIFICATION AUTHORITY DTIC ELECTED | | 3. DISTRIBUTION/AVAILABILITY OF REPORT unlimited | |
| 2b. DECLASSIFICATION/DOWNGRADING SCHEDULE OCT 0 2 1987 | | 5. MONITORING ORGANIZATION REPORT NUMBER(S) AFOSR-TR- 87-1330 | |
| 4. PERFORMING ORGANIZATION REPORT NUMBER(S) CD D | | 7a. NAME OF MONITORING ORGANIZATION AFOSR/NM Bolling AFB DC 20332-6448 | |
| 6a. NAME OF PERFORMING ORGANIZATION Center for Mathematical System Theory | | 7b. ADDRESS (City, State, and ZIP Code) AFOSR/NM Bolling AFB DC 20332-6448 | |
| 6c. ADDRESS (City, State, and ZIP Code) University of Florida Gainesville, FL 32611 | | 9. PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER AFOSR. 85-0186 | |
| 8a. NAME OF FUNDING/SPONSORING ORGANIZATION AFOSR/NM | | 10. SOURCE OF FUNDING NUMBERS | |
| 8b. OFFICE SYMBOL (if applicable) NM | | PROGRAM ELEMENT NO. PROJECT NO. TASK NO. WORK UNIT ACCESSION NO. | |
| 8c. ADDRESS (City, State, and ZIP Code) Bldg. 410 Bolling Air Force Base Washington, DC 20332 | | 6102 F 3304 A1 | |
| 11. TITLE (Include Security Classification) Mathematical Techniques for System Realization and Identification | | | |
| 12. PERSONAL AUTHOR(S) Professor R. E. Kalman | | | |
| 13a. TYPE OF REPORT Final | | 13b. TIME COVERED FROM 6/1/85 TO 3/31/87 | |
| 14. DATE OF REPORT (Year, Month, Day) 870720 | | 15. PAGE COUNT 5 | |
| 16. SUPPLEMENTARY NOTATION | | | |
| 17. COSATI CODES | | 18. SUBJECT TERMS (Continue on reverse if necessary and identify by block number) | |
| FIELD | GROUP | SUB-GROUP | |
| | | | |
| | | | |
| 19. ABSTRACT (Continue on reverse if necessary and identify by block number) The period covered by this final report is unusually short compared to earlier reporting periods. In addition, this happened to be a time when various organizational changes were taking place at the Center, with the result that there was no long-term Postdoctoral Fellow in residence during the reporting period. The number of short-term visitors was, however, somewhat above normal. This situation is changing and will present a different picture during the next reporting period. | | | |
| 20. DISTRIBUTION/AVAILABILITY OF ABSTRACT <input checked="" type="checkbox"/> UNCLASSIFIED/UNLIMITED <input type="checkbox"/> SAME AS RPT <input type="checkbox"/> DTIC USERS | | 21. ABSTRACT SECURITY CLASSIFICATION | |
| 22a. NAME OF RESPONSIBLE INDIVIDUAL May James M. Crowley | | 22b. TELEPHONE (Include Area Code) 301-207-4334 | |
| | | 22c. OFFICE SYMBOL NM | |

FINAL TECHNICAL REPORT **AFOSR-TR. 87-1330**

Air Force Office of Scientific Research Grant 85-0186

June 1, 1985 through March 31, 1987

with

Center for Mathematical System Theory

University of Florida, Gainesville, FL 32611

MATHEMATICAL TECHNIQUES FOR
SYSTEM REALIZATION AND IDENTIFICATION

Professor R. E. Kalman
Principal Investigator



| | |
|--------------------|--|
| Accession For | |
| NTIS CRA&I | <input checked="checked" type="checkbox"/> |
| DTIC TAB | <input type="checkbox"/> |
| Unannounced | <input type="checkbox"/> |
| Justification | |
| By | |
| Distribution/ | |
| Availability Codes | |
| DTIC | Avail and/or Spec |
| A-1 | |

1. BRIEF SUMMARY OF ACTIVITIES UNDER GRANT

The period covered by this final report is unusually short compared to earlier reporting periods. In addition, this happened to be a time when various organizational changes were taking place at the Center, with the result that there was no long-term Postdoctoral Fellow in residence during the reporting period. The number of short-term visitors (scientific "consultants") was, however, somewhat above normal. This situation is changing and will present a different picture during the next reporting period.

A detailed list of activities is given in Section 2.

The following comments are intended to place the publications in perspective.

BIRGET's research on finite semigroups is an important adjunct to the main Center efforts on algebraic system theory. The paper BIRGET [1986] is one of the results of his postdoctoral work at the Center. We are maintaining close contacts with him; there is a possibility of his rejoining the Center at a later time, at least as a visitor.

KHARGONEKAR and TANNENBAUM [1985] is the final publication of work reported for the previous period. Using new ideas (mainly due to KHARGONEKAR) related to advanced classical complex-variable analysis, it is now possible to compute (rigorously) the gain margin of a single-loop control system. This is an important classical problem in control theory which was heretofore treated only by questionable approximation methods. Unfortunately, the related (and even more important) problem of calculating the phase margin is not accessible by the same method of KHARGONEKAR and TANNENBAUM, and remains at present unsolved.

The paper KALMAN [1986] of the Principal Investigator is intended as a conceptual summary of the many current objections to the entrenched methodology for statistics, especially as regards applications to econometrics and system identification. The essential point is that one cannot treat noise in the data by simply guessing what the noise is. Extensive computer experiments performed at the Center (in collaboration with C. Los, results not yet

published) indicate that noise in the data is often quite different from what might be assumed according to the standard recipes of statistics. It is interesting, from the point of view of scientific philosophy, that the view expressed in KALMAN [1986] was clearly articulated and defended already by NEWTON, some 200 years ago. It is interesting that one can do research simply by better understanding the past.

The very recent papers by EMRE and SEO deal with the extension of algebraic system theory to certain infinite-dimensional problems. (Algebraization" of infinite dimensional systems.) EMRE is a former Center member. He was a senior Postdoctoral Fellow at the Center during the summer of 1986. We are maintaining close contacts with him.

Since its establishment in 1972, research at the Center for Mathematical System Theory has generated over 135 published papers. At the same time, the Center has served as a focal point for a considerable part of the system-theoretic research in the U. S. and elsewhere, through an active visitor program and through recruitment of outstanding doctoral students. This is especially true for the development and application of advanced algebraic and algebraic-geometric techniques in the system-theoretic context.

The Center is an interdisciplinary, interdepartmental group, a basic function of which is to provide coordination and collaboration between advanced mathematics and engineering. This is critical for a research program of this type. Direct interaction between persons of different but overlapping backgrounds is important not only in optimizing the chances of success in research but also in assuring that the results will be disseminated to wider engineering circles and facilitating subsequent practical utilization.

The national and international recognition achieved by the Center reflects a vigorous and effective research organization. We expect to fully continue the strong research activities at the Center in the future.

2. PUBLICATIONS SPONSORED BY THE GRANT

J.-C. BIRGET

- [1985] "Structure of finite semigroups and generalizations"; in PROCEEDINGS OF THE 1984 MARQUETTE CONFERENCE ON SEMIGROUPS (K. Byleen, P. Jones, and F. Pastijn, eds.), Marquette University, Milwaukee.
- [1986] "The synthesis theorem for finite regular semigroups, and its generalization"; Dept. of Computer Science, University of Nebraska, Lincoln.

E. EMRE and J. H. SEO

- [1986] "A realization theoretic solution of two analytic matrix equations with application to stabilization of infinite dimensional systems", Dept. of Electrical Engineering, Texas Tech University, Lubbock.
- [1987] " H^∞ solutions of Bezout type equations and stabilization of a class of infinite dimensional systems", Dept. of Electrical Engineering, Texas Tech University, Lubbock.

R. E. KALMAN

- [1986] "The problem of prejudice in scientific modeling"; to appear in Recent Advances in Communication and Control Theory (Proceeding of Symposium in honor of A. V. Balakrishnan, June 1987, Washington, DC).

P. P. KHARGONEKAR and A. TANNENBAUM

- [1985] "Non-Euclidian metrics and the robust stabilization of systems with parameter uncertainty", IEEE Trans. on Automatic Control, AC-30.

3. PERSONNEL SUPPORTED UNDER THE GRANT

Professor R. E. Kalman, Principal Investigator (partial summer support only).

Dr. J. C. Birget, postdoctoral fellow (1983-1985) (now on the faculty of University of Nebraska).

Dr. D. F. Findley, consultant, US Department of Commerce, Washington, DC.

Dr. C. A. Los, consultant, Federal Reserve Bank of New York.

Dr. Y. Rouchaleau, consultant, Ecole Nationale Supérieure des Mines, FRANCE.

4. VISITORS TO THE CENTER

- A. Antoulas, Rice University, Houston, TX
- L. Baratchart, INRIA, FRANCE
- A. Coppel, Australian National University, AUSTRALIA
- P. Dhrymes, Columbia University, New York, NY
- E. Emre, Texas Tech University, Lubbock, TX
- E. Engeler, Swiss Federal Institute of Technology, SWITZERLAND
- D. F. Findley, US Department of Commerce, Washington, DC
- I. Hammer, Case Western Reserve University, Cleveland, OH
- H. Jurgensen, University of Western Ontario, CANADA
- A. Lindenmayer, University of Utrecht, THE NETHERLANDS
- C. Los, Federal Reserve Bank of New York
- G. Marro, University of Bologna, ITALY
- T. Matsuo, Nagoya University, JAPAN
- Y. Rouchaleau, Ecole Nationale Supérieure des Mines, FRANCE
- D. Saari, Northwestern University, Evanston, IL
- J. Waldvogel, Swiss Federal Institute of Technology, SWITZERLAND

END

12-87

DTIC